EX PARTE OR LATE FILED

AIRTOUCH™
Communications
The new name for PacTel

ORIGINAL

DOCKET FILE COPY ORIGINAL

Kathleen Q. Abernathy
Vice President
Federal Regulatory

AirTouch Communications
1818 N Street N.W.
Washington, DC 20036

Telephone: 202 293-4960
Facsimile: 202 293-4970

RECEIVED

MAY 2 1994

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

May 2, 1994

EX PARTE

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, NW, Room 222
Washington, DC 20554

RE: GEN Docket 90-314, Amendment of the Commission's Rules to Establish New Personal Communications Services

Dear Mr. Caton:

On behalf of AirTouch Communications, I provided the information set forth in the attached documents to John Reed, FCC Office of Engineering and Technology regarding the proceeding indicated above. Please associate this material with the above-referenced proceeding.

Two copies of this notice were submitted to the Secretary of the FCC in accordance with Section 1.1206(a)(1) of the Commission's Rules.

Please stamp and return the provided copy to confirm your receipt. Please contact me at 202-293-4960 should you have any questions or require additional information concerning this matter.

Sincerely,

Kathleen Q. Abernathy

Kathleen Q. Abernathy

Attachment
cc: John Reed

No. of Copies rec'd 0+1
List ABCDE

RECEIVED

MAY - 2 1994

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

AIRTOUCH COMMUNICATIONS

Maximum transit power for PCS Base Stations

Maximum transmit power for PCS Base stations

The required EIRP from a base station can be determined by examining the imbalances between the uplink and downlink (from and to a mobile station) in the system. The main differences are due to the ability to use more advanced reception techniques at the base station as opposed to the mobile. This is essentially due to less constraints on cost and power at the base station. Because of the improved reception at the base station more power must be radiated from the base station in order to provide the same quality of link to the mobile (since the mobile is slightly deafer).

Once these differences are quantified the base station transmit power is then dependant on the gain of the antenna used for transmission. Very often the same antenna is used for transmission and reception by the base station (to ensure the same coverage, to reduce cost, and to reduce environmental impact) or at least the same antenna type. This antenna gain effects both the uplink and downlink in the same way. A higher gain antenna improves both the ability of the base station to receive and the mobile station to receive.

Quantification of link imbalances

Several factors affect the imbalance between the uplink and downlink of mobile radio system.

RECEIVER SENSITIVITY: Due to lesser constraints on cost, size and power at the base station the receiver sensitivity can be improved relative to the mobile station receiver sensitivity. Better noise figures on Low noise amplifiers used in the base station receive chain combined with more powerful equalizer and demodulation signal processing can increase the base station sensitivity relative to the mobile by around 5 dB.

RECEIVE DIVERSITY: Again, due to lesser constraints on cost, size and power at the base station, several receive chains can be implemented and combined in order to improve the base stations reception capability. Optimal algorithms nave been developed to extract almost theoretical gains using this approach. The effect of receive diversity is to mitigate the fading probability and reduce non-equalizable intersymbol interference. Generally two receive chains are implemented for receive diversity since additional chains provide less additional gain (diminishing returns). For planning purposes figures of between 3 to 5 dB gain tend to be used in existing mobile radio systems in urban areas. However there are circumstances when receive diversity provides considerably more gain, particularly in rural and hilly areas. For example under the GSM RA250 channel (rural area), channel simulations indicate that gains of around 13 dB can be achieved (GSM Base-Station Antenna Diversity Using Soft Decision Combining on Up-link and Delayed-Signal Transmission on Down-link, Preben E. Mogensen,IEEE VTC 1993).

Collecting these two areas together we have a combined imbalance between the uplink and downlink of 18 dB (5 + 13). What this essentially means is that the base station has to inject 18 dB more power into its transmit antenna in order to balance the quality of the communication link than the mobile does. So for example, with the mobile injecting 33 dBm (2 Watts) into its transmit antenna, the base station has to inject 51 dBm (about 100 Watts) into its antenna.

Base Station Antenna Gains

The ultimate EIRP required for the base station depends on the base station antenna gain. This affects both the uplink and downlink in the same way. For existing mobile radio systems sectorised base station sites are common, permitting extended range and more control over inter and intra system interference. At 800 MHz the antennas used have gains of up to 15 dBi. At 1.9 GHz and above, for the same physical size, higher gain antennas can be constructed (The DCS 1900 trial operated by Telesis Technologies Laboratory operates using 18 dBi gain antennas).

In addition to standard antennas, phased array antennas can achieve controllable pencil beams with effective gains greater than 25 dBi.

What does it all mean?

The required EIRP from a base station to balance the uplink and downlink in a mobile system, incorporating optimal two path diversity at the base station, in a rural area and using, lets say 20 dBi gain antennas and assuming that the mobile station is capable of utilizing 33 dBm of power is:

18dB (link imbalance) + 33 dBm (mobile transmit power) + 20 dBi (Base station antenna gain)

= 71 dBm EIRP

This value is equivalent to 12,500 Watts EIRP

The heart of the problem

The above value may seem to be very high, but can easily be achieved at a base station for all the right reasons. The real problem is caused by trying to put a limit on the actual value. One can always find certain circumstances which will require additional transmit EIRP. If one considers the use of transmit diversity in the base station (this helps the mobile station receive, by up to 10 dB better) and say use 1 Watt transmission (as in DCS 1800) the above computation falls to 58 dBm EIRP (630 Watts). However, transmit diversity has never been implemented and under certain circumstances it gives no gain at all.

Due to these reasons no explicit limitation on EIRP should in fact be legislated, mainly due to the current advances in phased array technology which could be precluded. What should be legislated are the particular effects of high EIRP when managed incorrectly. These include biohazards, interference into other communication systems and the like. It is quite easy to exceed several kiloWatts of required EIRP through the use of phased arrays and even normal antennas, yet reduce the interference into other communication systems. A limitation on EIRP is artificial. For example microwave links operate with at least a KiloWatt of EIRP, essentially due to their high gain antennas, the actual RF energy injected into the antenna is in the order of a 1 Watt or less. The High EIRP is in fact a measure of the directionality of the radiation, reducing interference problems.

Pactel Corporation, now AirTouch Communications proposed a 1500 Watt EIRP limit as the <u>minimum</u> necessary to preserve PCS flexibility and viability if an EIRP limit is required.